

HISTORY OF INSECT COLLECTION AND A REVIEW OF INSECT DIVERSITY IN SRI LANKA

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ABSTRACT

The information on numerous insects species of Sri Lanka is scattered in the taxonomic literature. In this review of the insects of Sri Lanka, history of insect collecting in Sri Lanka is traced and an attempt has been made to document the number of insect species in different orders, recorded from Sri Lanka. Taxonomic studies by specialists, mainly in Europe and North America, on specimens collected from Sri Lanka have resulted in the present knowledge of Sri Lanka's insect fauna. According to literature, insects belonging to all 32 orders except Grylloblattodea have been recorded from the country. Of the larger orders, Coleoptera, Lepidoptera, and Hymenoptera, about 3033, 2158 and 1519 species respectively, have been recorded from the island. Based on available literature the total number of insect species recorded from the island is about 11144.

INTRODUCTION

Biodiversity is important, whether viewed from ecological, economic, aesthetic or other perspectives. This is an idea that has gained general acceptance today. It is also recognized that loss of biodiversity, due mainly to human influence, is taking place at an alarming rate, even though our understanding of biodiversity remains pitifully inadequate in most parts of the world. Sri Lanka, as a developing nation in the tropics, exemplifies a particularly critical situation. Sri Lanka has a high genetic, species and ecosystem diversity, yet despite appreciation of these basic facts and the attention given to them, detailed knowledge of Sri Lanka's biodiversity is poor. While the range of ecosystems represented in Sri Lanka is valued, appreciation of species diversity in them is low. The interrelations among organisms at the community level is at best elementary. Lack of knowledge of species diversity is particularly a problem with regard to invertebrates. The plant life of Sri Lanka is better known compared to its animal life. Among the animals a few groups are better known than others. Vertebrates such as mammals, birds and fish are better known than most invertebrate groups, including the insects.

Insects are the earth's most diverse organisms, accounting for about half of the described species of living things and about three-quarters of all known animals, and it is estimated that more species of insects than known at present remain to be discovered. Given the fact that most insect groups reach their highest diversity in the tropics it can easily be said that Sri Lanka's insect fauna must represent a large part of its biodiversity. Unfortunately, despite this dominant position insects are rarely included in accounts of

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biodiversity in Sri Lanka, or, if they are included at all, only a very few insect groups featured in such analyses (Table 1). The usual excuse for this negligence is lack of information on Sri Lankan insects due to the inadequacy of taxonomic studies on the group. This, however, reflects a misunderstanding on the status of our knowledge of insect diversity in Sri Lanka. A list of insects from Sri Lanka published as far back as 1861 included the names of 2007 insect species in 9 orders (Tennent, 1861) and a list of Sri Lankan beetles in the collection of the Colombo Museum published in 1890 included some 1510 species (Haly, 1890). The discovery of Sri Lanka's insect fauna has made significant progress since the nineteenth century. While it is true that our knowledge of a few insect groups still remains very poor, for most groups of insects the situation is much better. Although many new species of Sri Lankan insects undoubtedly remain to be discovered, a large number of insect species representing all the major groups that can be expected to be found in Sri Lanka have already been recorded from the island by numerous taxonomists since the eighteenth century. Unfortunately, most of this information is scattered in the taxonomic literature and unavailable locally. The lack of a continuously active national insect collection has also contributed to the perception of insects as a poorly-known group of animals in Sri Lanka.

As the most diverse group of organisms, insects play a major role in ecosystem diversity and sustainability. Studies on biological diversity should therefore recognize the importance of insects and of their conservation. The purpose of this paper is to review the taxonomic literature and establish the fact that insects are the most species rich group of organisms in the country and to emphasize the need of more studies on Sri Lankan insects.

Table 1
Insect groups and their species diversity quoted in biodiversity accounts in Sri Lanka

Insect Group	State of the Environment(2002)	Statistical Compendium (2000)	Soba, (1994)	Natural Resources of Sri Lanka. (1991)
Mayflies	18	18	18	Not given
Mosquitoes	139	139	139	131
Carabid beetles	525	525	540	Not given
Blister beetles	Not given	Not given	15	15
Butterflies	243	243	242+	Not given
Dragonflies	117	Not given	Not Given	Not given

History of Insect collection in Sri Lanka

Knowledge about fauna of a particular area begins with collection of specimens, followed by their study by specialist taxonomists, leading to the identification of previously known species and the naming and description of new species. The collection of Sri Lankan insects and other invertebrates for systematic study has a history that goes back about 150 years.

Robert Templeton (1802-1892), a doctor with the British forces, collected insects and other animals while stationed in Sri Lanka between 1839-1848. Most of his specimens are at the Natural History Museum, London. New species based on his specimens were described by Francis Walker (1809-1874), John Obadiah Westwood (1805-1893) and others in 1850-1870. Edgar Leopold Layard (1824-1900), who served in the Ceylon Civil Service in 1846-1853, collected Lepidoptera and other animals; his specimens are mostly in the Natural History Museum, London. John Nietner (?-1874) was a coffee planter who was also an excellent entomologist. He made large collections of insects and other animals which he sent abroad for study by experts such as Victor Ivanovich Motschulsky (1810-1871) at St. Petersburg, Carl August Dohrn (1806-1892) at Stettin, G. Kraatz (Staphylinidae; specimens in Deutsches Entomologisches Institut, Eberswalde), Hermann August Hagen (1817-1893) at Konigsberg ('Neuroptera' specimens now in Museum of Comparative Zoology, Harvard), H. Loew (1807-1879) (Diptera, specimens in the Berlin Museum), and many others. Nietner himself published several papers on Coleoptera. He was the first entomologist to take an interest in the insect pests of Sri Lanka and published a booklet on the pests of the coffee tree in 1861. George Henry Kendrick Thwaites (1811-1882), who was the Superintendent of the Royal Botanic Gardens, Peradeniya (1849-1857), was also a naturalist who made large collections of insects and other invertebrates, which he sent abroad for study (such as the Natural History Museum, London). Alois Humbert (1829-1887) from Switzerland visited Sri Lanka in 1858-1860 and collected many types of invertebrates, including insects. His specimens are at the Museum d'Histoire Naturelle, Geneva. John Pole was a planter at Scarborough Estate (Upcot) and an amateur entomologist who collected Lepidoptera; his specimens are in the National Museum, Colombo. George Lewis (1839-1926) collected beetles and other insects on a visit to Sri Lanka in 1881-1882; his specimens are in the Natural History Museum, London. John William Yerbury (1847-1927) was an army officer who collected Diptera and many other groups while based at Trincomalee in the 1880s; his specimens are in the Natural History Museum, London. The French arachnologist Eugene Simon (1848-1924) collected insects and other land arthropods on a visit to Sri Lanka. His specimens are at the Museum National d'Histoire Naturelle, Paris. F. M. Mackwood (1843-1931), a businessman in Colombo, was a keen amateur lepidopterist. His specimens are at the National Museum, Colombo and the Natural History Museum, London.

Edward Ernest Green (1861-1949) of Pundaluoya was the son of a coffee planter. A gifted naturalist interested particularly in insects, Green, like Nietner, was a pioneer in the study of insect pests in Sri Lanka. He did valuable work on insects attacking coffee and tea and his publications, brought recognition to his studies. Green's entomological work connected with plantations (at first done voluntarily) eventually led to his appointment in 1899 as the 'Government Entomologist', with an office at the Royal Botanic Gardens at Peradeniya. His monograph on the scale insects of Sri Lanka, 'Coccidae of Ceylon' (1896-1922, 5 parts) is a classic. Green's specimens are at the Natural History Museum, London, Department of National Museums, Colombo, and Horticulture Research and Development Institute, Gannoruwa. The coleopterist Walther Horn (1871-1939) collected beetles and other insects in Sri Lanka. George Morrison Reid Henry (1891-1983) was born in Sri Lanka, a son of a planter. Although with little formal education, his great talent as a naturalist and an artist brought him to the attention of Joseph Pearson (Director of Colombo Museum) and he was appointed Assistant in Systematic Entomology at Colombo Museum, a post he held

from 1913-1946. He built up the collection of the Museum through collecting expeditions, purchase and donations, and had the collections identified by specialists at the Natural History Museum, London, and elsewhere. He himself became an expert on the Orthoptera of Sri Lanka (and South India) and published many papers on these insects. His specimens are at the Department of National Museums, Colombo and the Natural History Museum, London. Fred Keiser from Switzerland conducted an expedition in Sri Lanka in 1953-1954 and the material he collected (Diptera and many other insects) are at the Naturhistorisches Museum, Basel. Paul A. Remy visited Sri Lanka in 1959 and collected soil micro-arthropods; his specimens are at the Museum National d'Histoire Naturelle, Paris. On the invitation of the Director of National Museums, Per Brinck, Lennart Cederholm and Hugo Andersson from Sweden visited Sri Lanka on an expedition in 1962 (Lund University Ceylon Expedition) and made extensive collections of all land and freshwater invertebrates. The results of study of this material by several specialists appeared in many publications, including the four volumes of *Entomologica Scandinavica*, Supplements 1, 4, 11 and 30, in 1971-1988. Constantine Herbert Fernando collected freshwater invertebrates in Sri Lanka in the 1960s & 1970s and had this material studied by specialists; his specimens are at the National University of Singapore. G. Punchi Banda Karunaratne (1930-1996) was the Curator in Entomology at the Department of National Museums, Colombo, and was widely respected for his encyclopedic knowledge of the Sri Lankan fauna. His participation in the Smithsonian Institution insect project in Sri Lanka contributed greatly to its success. Specimens collected by him are held at the National Museum, Colombo and the National Museum of Natural History, Washington DC. Karunaratne himself did valuable work on aquatic Hemiptera. Karl von Vorse Krombein (b. 1912) of the United States National Museum of Natural History (Smithsonian Institution) was the Principal Investigator of the project 'Biosystematic Studies of Ceylonese Insects' which was in operation from 1969-1980. The project resulted in major contributions to our knowledge of all groups of Sri Lankan insects. The work of Krombein and his collaborators on Hymenoptera of Sri Lanka is of special importance. Identified specimens from the project are at the Smithsonian Institution, U.S.A, Department of National Museums, Colombo and the Department of Zoology, University of Peradeniya. Claude Besuchet and Ivan Lobl from Switzerland conducted an expedition to Sri Lanka in 1970 and paid particular attention to small insects and other arthropods of soil, leaf litter, fungi, etc. Their specimens are at the Museum d'Histoire Naturelle, Geneva, and many publications have been made based on them. Ferdinand Starmuhlner of Vienna and H. H. Costa of the University of Kelaniya led a hydrobiological expedition in 1970 (Austrian-Ceylonese Hydrobiological Expedition) which collected freshwater invertebrates, particularly of mountain streams. The results of this expedition appeared mostly in the *Bulletin of the Fisheries Research Station, Sri Lanka* (1971-75). Villy Aellen and Pierre Strinati conducted a biospeleological expedition to Sri Lanka in 1970 and collected various cave-dwelling arthropods. Their material is at the Museum d'Histoire Naturelle, Geneva. In addition to the collections mentioned above, several individual experts on specific groups have made private collecting expeditions to Sri Lanka over the years. Taxonomic studies by specialists, mainly in Europe and North America, on specimens collected in this way have contributed to our present knowledge of the insect fauna of Sri Lanka.

Documented Insect Diversity in Sri Lanka

While there is general agreement on the limits of the more distinctive extant insect orders, the classification of certain orders like Neuroptera is in a state of flux. For the sake of convenience we have followed the classification given in 'The Insects of Australia' (1991), in which 32 insect orders are recognized.

All 32 recognized orders of insects except Grylloblattodea are known to be represented in Sri Lanka. Based on published information surveyed during this study, the total number of insect species recorded from Sri Lanka is 11144 (Table 2). This amounts to 53% of the total species diversity and 81% of the animals diversity (Fig. 1), as reported in the Statistical Compendium (2000) and State of the Environment (2002). A brief description of the status of each insect order represented in Sri Lanka is given below.

Collembola (Springtails), Protura, Diplura and Thysanura (Bristletails)

Apterygote insects are all small and primitively wingless. We have found the names of 19 species of Collembola, 1 species of Proturan, 14 species of Diplura and 9 species of Thysanura and 2 species of Microcoryphia have been recorded from Sri Lanka (Table 2). Although collembolans are common insects they are seldom observed due to their small size. Most of them live in soil, leaf mold, under bark, decaying logs and fungi. Some species are pests of cultivated mushrooms in Sri Lanka. Collembolans are detritivores, important in the recycling of organic matter.

Diplurans (bristletails) also occur in soil, leaf litter, under stones and rotting wood and are important for organic recycling. Silverfish are probably the best known members of the order Thysanura. We have found only names of nine species from Sri Lanka. Thysanurans live in ant or termite nests, caves, in debris and inside houses.

Ephemeroptera (Mayflies)

Mayflies are small to medium-size elongate and delicate insects with two long threadlike tails. The adult life is very short while the nymphs are aquatic and long lived. The nymphs feed mainly on algae and detritus and many are active at night. The 46 species recorded from Sri Lanka belong to seven families.

Odonata (Dragonflies and Damselflies)

These are fairly well recognized insects in Sri Lanka. They are relatively large, attractive and spend most of their time on wings. Their immature stages are aquatic. Both adults and nymphs are predacious on smaller insects and other organisms. de Fonseka (1997) compiled a guide to Sri Lankan Odonata, according to which there are 117 species in 11 families recorded from Sri Lanka.

Orthoptera (Grasshoppers and Crickets)

Thanks to the studies of G. M. Henry, this order (Orthoptera *sensu stricto*) is one of better known groups of Sri Lankan insects, though no single monograph of Sri Lankan species is available. Several families represented in the Colombo Museum collection were catalogued by Sandrasagara, (1949; 1954), while the world catalogues of Otte provide updated nomenclature and classification.

Phasmatodea (Stick-insects and Leaf-insects)

The systematics of this order has for long been in a chaotic state. Prior to Hennemann's (2000) work, 85 nominal species of the order were recorded from Sri Lanka. Hennemann synonymized 19 species and described 3 new species.

Mantodea (Mantids)

Mantids are moderately large predacious insects related to cockroaches in which the first pair of legs is raptorial. Some 56 species are recorded from Sri Lanka.

Dermaptera (Earwigs)

Earwigs are elongate flattened insects with a pair of forceps-like cerci. Adults are winged or wingless and females display maternal behavior. They feed on dead and decaying plant matter and a few species are predacious. Earwigs are nocturnal and they can be found in debris, under bark and stones, etc. Thanks to the studies of Malcolm Burr (1901), Alan Brindle (1977) and others, this is one of the best known groups among the smaller insect orders in Sri Lanka.

Isoptera (Termites)

One of the most familiar groups of insects in Sri Lanka, termites are eusocial insects with a highly developed cast system. Some species live in subterranean habitats while others occur above ground in living or dead trees. They range from the little-noticed furniture destroying *Cryptotermes* species to mound-building *Odontotermes* species with their spectacular mating flights. The recent monograph of termites of the Indian subregion records 56 species from Sri Lanka (Chhotani, 1997).

Embioptera (Webspinners)

Webspinners are unlikely to be identified by casual observers. They are small and slender insects, winged males resembling winged termite males. Females are always wingless. Webspinners have silk glands on the front tarsi and live in silken galleries constructed on debris, soil cracks epiphytic plants, lichens, etc. They feed on plant material. Only four species are known from Sri Lanka (Ross, 1979).

Plecoptera (Stoneflies)

Medium to small size soft bodied insects with two pairs of membranous wings. Stoneflies are found near streams and tanks. Nymphs are aquatic and found under stones of streams and tank shores. Ten species have been recorded from Sri Lanka (Zwick, 1980; 1982).

Zoraptera

Zoraptera is a small group of minute insects less than 3 mm in length. They look like termites. Some species do have wings. Only a single species is known to occur in Sri Lanka (Silvestri, 1913).

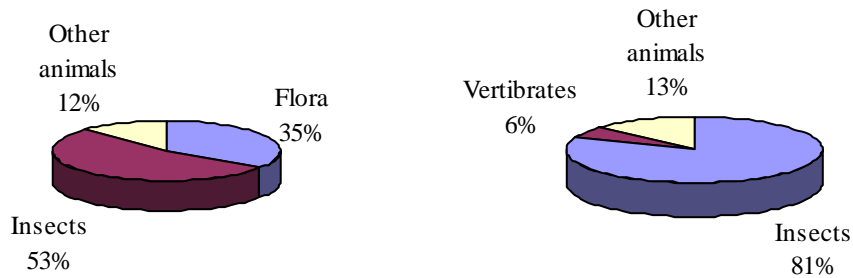


Figure 1. Insects compared to Species diversity data given in the Statistical Compendium on Natural Resource Management in Sri Lanka – 2000

Phthiraptera (Lice)

Mallophaga (chewing lice) and Anoplura (sucking lice) are wingless external parasites of birds and mammals. Sucking lice feed on the blood of their hosts, while chewing lice feed on pieces of hair, feathers or skin of their hosts.

Thysanoptera (Thrips)

Thrips too are minute (0.5-5.0 mm) slender bodied insects. Most have two pairs of wings with fringe of hairs. Many thrips are phytophagous feeding on flowers, leaves fruits, twigs or buds. The order includes a number of serious pests of plant crops. The first comprehensive work on Sri Lankan Thysanoptera was by Schmutz (1913). In this study he described 43 new species. Only other work on Sri Lankan thrips had been by Oda *et al.* (1997).

Hemiptera (Bugs)

Hemiptera is one of the larger insect groups. Many could identify bugs by the characteristic odor most species emit. Few families from Sri Lanka have been included in recent catalogs which include, Berytidae (13 species; Henry & Froeschner, 1998), Lygaeidae (139 species; Slater, 1979), Reduviidae (138 species; Caprites, 1990), and Tingidae (28 species; Drake & Ruhoff, 1965). One of the larger families, Miridae is being studied at present (Wijesekara & Henry, 2000).

Homoptera

Homoptera includes a very diverse group of insects showing considerable morphological variation. Cicadas, Hoppers, Psyllids, Whiteflies, Aphids, Mealy bugs and Scale insects are all belongs to Homoptera. Mealybugs and Scale Insects of Sri Lanka have

been well studied by E.E. Green and he has published five-volume monograph on them. Planthoppers and Aphids have also been cataloged for Sri Lanka (Fennah, 1973-75; Wijeratna & Edirisinghe, 1999).

Neuroptera

Unavailability of records indicates that this is one of the least studied groups in Sri Lanka. Most Neuroptera larvae are predators and hence beneficial insects of agriculture. Some species are parasitic on spider eggs. We have found records of 33 species, occurring in Sri Lanka.

Coleoptera (Beetles)

Coleoptera is the largest group of insects in the world and in Sri Lanka as well. They vary in size from less than a millimeter to over 12 centimeters. Beetles are found in every ecosystem in large numbers. Bruchidae, Cucujidae, Lathridiidae, Languriidae, Platypodidae, Scolytidae, and Tenebrionidae, are few of the families from Sri Lanka which have been recently studied or catalogued by various taxonomists. There are 30 species of Lampyrids which most of Sri Lankans recognize as fireflies (McDermott, 1966).

Strepsiptera (Stylopids or Twisted-winged Parasites)

Stylopids form a small group of bizarre-looking parasitic insects unlikely to be encountered by casual observers. Males have the hind pair of wings well-developed and the fore-wings reduced. Females are wingless and usually do not leave their hosts. Hosts include silverfish, crickets, planthoppers, bees, wasps and ants. Kifune (1997) records 20 species from Sri Lanka, while Kathirithamby (1994) reviews the order in Sri Lanka and provides a comprehensive bibliography.

Mecoptera (Scorpionflies)

Scorpionflies do not appear to be well represented in Sri Lanka, only two species being known from the island so far (Rust and Byers, 1976). Their larvae are caterpillar-like and live on the soil under thick vegetation and they are scavengers.

Trichoptera (Caddisflies)

These moth-like small insects are found closer to aquatic habitats. Their larvae are caterpillar-like and live in water. Some larvae make cases and others construct underwater nets. The 188 species recorded from Sri Lanka belong to 18 families (Schmid, 1958; Malicky, 1973).

Lepidoptera (Butterflies and Moths)

Butterflies and moths are an easily recognized group of insects. Butterflies represent only a few families of the order, which consists of a total of 113 families. The butterflies of Sri Lanka have been well studied and consist of 234 species in ten families. However, the moths, particularly the micro-lepidopterans, are poorly known. The present study revealed 2158 species of Lepidoptera recorded for Sri Lanka, making it the second largest group. The family Lecithoceridae has been recently revised for Sri Lanka (Wu & Park, 1998; 1999).

Diptera (True Flies)

Diptera comprise the fourth largest order of insects in the world. A few families contain species that serve as vectors of disease-causing pathogens or are pests of crops. Delfinado & Hardy (1973-1977) cataloged the species of flies in the Oriental region. Since then a few families such as the Agromyzidae (Wijesekara, 2002), Stratiomyidae (Hauser, 1999), Tabanidae (Burger, 1981) from Sri Lanka have been studied further.

Siphonaptera (Fleas)

Fleas are a group of small wingless ectoparasitic insects, which feeds on the blood of birds and mammals. Records show that there are 20 species in Sri Lanka.

Hymenoptera (Ants, Wasps, Bees, etc.)

Hymenoptera is probably the second largest group of insects in the world. Ants and wasps (Apocrita) are better studied in Sri Lanka. Many wasps groups were collected and studied by Krombine during the Smithsonian Project. Few other groups have been recently cataloged.

Diversity of Insects in Sri Lanka

The above account on variety and numbers of insects recorded from Sri Lanka indicates that they are the most diverse group of organisms in the country as in other parts of the world. This is by no means a complete study and an exercise to make a complete catalogue of insects known, would take years of painstaking cataloging effort with access to better libraries than what is available in Sri Lanka. Although insects comprise the most diverse and most important group of organisms in ecosystems, it is the group that has received the least attention from biologists, environmentalists and students of biodiversity. Not only are the numbers of already recognized species much higher than this preliminary account indicates, it is highly probable that comparable numbers of species unknown to science remain to be discovered in Sri Lanka. For example, a recent revision of the tribe Euplectrini (Hymenoptera: Eulophidae) from Sri Lanka revealed the presence of more than 11 new species after a relatively short period of collection in few localities in the country (Wijesekara & Schauff, 1994). With more species of insects than all other organisms combined, only 24 insect species are regarded as highly threatened in Sri Lanka, a situation which clearly demonstrates the extent of neglect of Sri Lankan insects. However, the list of Threatened Fauna of Sri Lanka includes 147 insect species (70 species of Odonata, 76 species of butterflies and 1 ant species) (IUCN, 1999). Of the threatened species 63 are considered as endemic. It is very likely that some of the recorded species of insects have already become extinct. Sri Lanka still have a high biological diversity while the pressure on natural habitats continues to increase. It is imperative that the necessary resources to study our rich insect fauna are made available sooner when some of the past diversity is still with us. Funding for cataloging the known insect fauna, for the study of lesser known groups and for training is immediately needed. It is also necessary to include insects in all the biodiversity conservation efforts in Sri Lanka.

Table 2
Number of insect species belonging to different orders recorded from Sri Lanka

Order	No. of Species	Reference*
Collembola	19	Ritter, 1910-11; Imms, 1912
Protura	01	Nosek, 1976
Diplura	14	Fernando, 1958; Pages, 1984
Thysanura	09	Silvestri, 1913
Microcoryphia	02	Wygodzinsky, 1957
Ephemeroptera	46	Hubbard & Peters, 1978; Hubbard, 1983; Muller-Liebenau & Hubbard, 1985
Odonata	117	De Fonseka, 1998
Orthoptera	350	Sandrasagara, 1949; Sandrasagara, 1954; Chopard, 1936
Phasmatodea	69	Hennemann, 2002
Dermaptera	71	Steinmann, 1989
Blattaria	66	Princis, 1963-1971
Mantodea	56	Giglio-Tos, 1927; Beier, 1956
Isoptera	56	Roonwal & Chhotani, 1989; Chhotani, 1997
Embioptera	04	Ross, 1979
Plecoptera	10	Zwick, 1980; Zwick, 1982
Zoraptera	01	Silvestri, 1913.
Psocoptera	67	Smithers, 1967; New, 1977
Phthiraptera	50	Lakshminarayana, 1986; Ferris, 1951
Thysanoptera	54	Schmutz, 1913; Palmer & Mound 1978
Hemiptera (44)	794	Dolling, 1986; Distant, 1902;1903; 1906; 1910; 1918; Henry & Froeschner, 1998; Pawar, 1973; Slater, 1979; Kormilev, 1987; Drake & Ruhoff, 1965; Caprites, 1990
Homoptera (35)	989	Metcalf, 1963; Metcalf & Wade, 1965; Fennah, 1973-75; Distant, 1916; Mound, & Halsey, 1978; Wijeratna & Edirisinghe, 1999; Varshney, 1985
Neuroptera (15)	33	Meinander, 1982; Oswald, 1998; Hagen, 1859; Templetan, 1861
Coleoptera (113)	3033	Arrow, 1910; 1917; 1931; Franz, 1982; Hammond, 1972; Wiesner, 1992; Hansen, 1999; Vazirani, 1977; Hlisnikovsky, 1972; Deleve, 1973; McDermott, 1966; Wittmer, 1979; Chatterjee, 1924; Chujo, 1972; Kaszab, 1979; Bonadona, 1986; Schedl, 1972
Strepsiptera (4)	20	Kathirithamby, 1994; Kifune, 1997
Mecoptera (5)	02	Rust & Byers, 1976
Siphonaptera	20	Iyengar, 1973,
Trichoptera (20)	188	Schmid, 1958; Malicky, 1973
Lepidoptera(124)	2158	Hampson 1892; 94; 95; 96; Wu & Park, 1998; 1999; Diakonoff, 1982; Fletcher, 1928; Scoble, 1999; D'Abbrera, 1998
Diptera	1341	Delfinado & Hardy, 1973; 1975; 1977; Jayasekera & Chelliah, Datta, 1983; Hauser, 1999; Burger, 1981; Wijesekara, 2002
Hymenoptera	1519	Krombein, 1979a; 1979b; 81;82; 83; 84; 85;. 96; Bolton, 1995; Wijesekara, 1994; 2001
Total	11144	

*Only the major references have been quoted

ACKNOWLEDGEMENT

We are grateful to Dr. C. Kudagama, Director, Horticulture Crops Research and Development Institute, Gannoruwa for reviewing and improving the manuscript.

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